**RTO MEETING PROCEEDINGS**

MP-IST-083

Military Communications with Special Focus on Tactical Communications for Network Centric Operations

(Les communications militaires, et plus particulièrement les communications tactiques pour les opérations réseaux-centrées)

Papers presented at the RTO Information Systems Technology Panel (IST)

Symposium held in Prague, Czech Republic, on 21-22 April 2008.
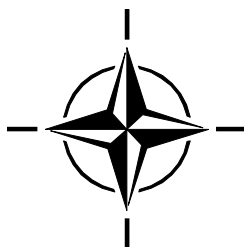
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The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective co-ordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also co-ordinates RTO's co-operation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- AVT   Applied Vehicle Technology Panel
- HFM   Human Factors and Medicine Panel
- IST   Information Systems Technology Panel
- NMSG   NATO Modelling and Simulation Group
- SAS   System Analysis and Studies Panel
- SCI   Systems Concepts and Integration Panel
- SET   Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier co-operation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

Military Communications with Special Focus on Tactical Communications for Network Centric Operations

(RTO-MP-IST-083)

Executive Summary

The Symposium brought together operational staff, developers, and researchers to examine the dynamic and critical nature of information flow in present and future military operations which demand high capacity, reliability, and robustness in the information grid. Current and projected military communication infrastructures, especially at the lowest tactical levels, may not meet requirements due to highly dynamic missions and organizations; urban and complex terrain and topology, high demand for complex services, interoperability, availability and quality. Typical tactical networks are characterized by low bandwidth, variable throughput, unreliable connectivity and energy constraints imposed by radio channels and mobile operations. This situation calls for detailed examination of already existing and emerging technologies, on-going research efforts, as well as development and documentation of effective tactics, techniques and procedures that fully support the deployment of tactical communication networks which operate in a fashion that enables Network Centric Operations.

The Symposium presentations fit into six related groupings: Software Defined Radio (SDR), Network and Resource Management, Performance, Urban Communications, Security, and Future Services in a Changing World. A mix of current, developing and future capabilities were presented to address the increasingly complex operational environments faced by NATO forces.

Dependency on communications, especially at the lowest tactical levels, has increased to compensate for loss of visual contact between small teams and to their parent organizations as they disappear in alleys, multi-story buildings, and subterranean tunnels. Increasing dependence on information exchange at all levels is driving the demand for greater communication availability and throughput. While communications dependency is rising, its performance suffers from radio frequency (RF) transmission range reductions caused by line-of-sight issues and attenuation due to buildings, structures and terrain; as well as interference from other local electromagnetic systems. All of this drives the development of new concepts of operations, requiring new tactical communication systems or novel ways of deploying or using existing tactical communication systems.

An important conclusion was that the land environment is the most challenging communications environment faced by NATO. The challenges come from a combination of factors that include: the number of items that need to be connected, terrain (especially urban), number of platforms supported (ship vs. plane vs. soldier), power, weight, and cost (a few expensive units vs. thousands of units).

Transformational programs need to be funded and deployed when fully developed. These efforts include: Software Defined Radio and Wireless Network after Next (WNaN). While progress is being made, there remain gaps that need continued emphasis:

- Ability to securely communicate information end-to-end.

- Ability to share/exchange voice/data with higher, lower, and adjacent units.

- Ability to gain/maintain situational understanding, to include position and timing.

- Ability to enable system and link information assurance measures.

- Ability to maintain and optimize network functions and resources, to include frequency spectrum.

Les communications militaires, et plus particulièrement les communications tactiques pour les opérations réseaux-centrées
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Synthèse

Ce symposium a réuni des opérationnels, des développeurs et des chercheurs en vue d'examiner la nature cruciale et dynamique du flux d'informations lors des opérations militaires présentes et futures qui exigent un réseau d'information fiable, robuste et doté de grandes capacités. Les infrastructures de communication militaires actuelles et en projet, en particulier aux niveaux tactiques les plus bas, peuvent ne pas répondre aux exigences d'organisations et de missions hautement dynamiques : topologie et terrain complexes et urbains, forte demande pour des services complexes, interopérabilité, disponibilité et qualité. Les réseaux tactiques typiques se caractérisent par une faible largeur de bande, un débit variable, une connectivité peu fiable et des contraintes énergétiques imposées par les canaux radio et les opérations mobiles. Une telle situation nécessite un examen attentif des technologies existantes et émergentes, des efforts de recherche soutenus, ainsi que le développement et la documentation de tactiques, techniques et procédures efficaces qui soutiennent pleinement le déploiement de réseaux de communications tactiques opérant de manière à permettre les opérations réseau.-centriques.

Les présentations du symposium s'inscrivaient dans six groupes apparentés : Radio logicielle (SDR), Gestion de réseaux et de ressources, Performances, Communications urbaines, Sécurité, et Futurs services dans un monde en mutation. Un panachage des capacités actuelles, en développement et futures fut présenté en vue de couvrir les environnements opérationnels de plus en plus complexes auxquels sont confrontées les forces de l'OTAN.

La dépendance envers les communications, particulièrement aux niveaux tactiques les plus bas, s'est accrue afin de compenser la perte de contact visuel entre les petites équipes et leur organisation mère lorsqu'elles disparaissent dans des allées, des immeubles à plusieurs étages ou des tunnels souterrains. La dépendance accrue envers l'échange d'informations à tous les niveaux génère une demande pour une meilleure disponibilité et un meilleur débit des communications. Alors que la dépendance envers les communications augmente, les performances de ces dernières souffrent de la réduction de portée de transmission des fréquences radio (FR) due à des problèmes de visibilité directe, à l'atténuation causée par les immeubles, les constructions et le terrain, ainsi qu'aux interférences provoquées par d'autres systèmes électromagnétiques locaux. Il en résulte le développement de nouveaux concepts d'opérations, nécessitant de nouveaux systèmes de communications tactiques ou de nouvelles façons de déployer ou d'utiliser les systèmes de communications tactiques existants.

Une conclusion importante est que l'environnement terrestre constitue l'environnement de communications le plus délicat auquel l'OTAN est confronté. Les défis proviennent d'une combinaison de facteurs comprenant : le nombre d'appareils à connecter, le terrain (notamment urbain), le nombre de plateformes supportées (navire, avion ou soldat), la puissance, le poids et le coût (quelques unités coûteuses ou des milliers d'unités).

Des programmes transformationnels doivent être financés et déployés lorsqu'ils seront pleinement développés. Ces efforts comprennent : la Radio logicielle et le Réseau sans fil after Next (WNaN). Bien que des progrès soient accomplis, des lacunes demeurent, sur lesquelles il convient de continuer à insister :

- La capacité de communiquer en toute sécurité des informations de bout en bout.

- La capacité de partager ou d'échanger des paroles ou des données avec les unités au-dessus, en dessous ou adjacentes.

- La capacité d'obtenir ou de conserver la compréhension de la situation, notamment en ce qui concerne la position et le minutage.

- La capacité de mettre le système en service et de relier les mesures d'assurance des informations.

- La capacité de maintenir et d'optimiser les fonctions et les ressources du réseau, notamment le spectre de fréquences.

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DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Supporting documents are attached to the report as separate files (MS Word, MS PowerPoint , PDF, HTM). Papers presented a

14. ABSTRACT

The dynamic and critical nature of information flow in present and future military operations demands high capacity, reliability, and robustness in the information grid. Current and projected military communication infrastructures, especially at the lowest tactical levels, may not meet requirements due to highly dynamic missions and organizations; complex terrain and topology, high demand for complex services, interoperability, availability and quality. Many research and standardization efforts have been undertaken in the commercial market aimed at delivering new capabilities to mobile users and improving performance of wireless communication networks. Direct implementation of these solutions in tactical environments is limited due to specific military requirements related to interoperability, accessibility, security, mobility, flexibility, and more. This situation calls for detailed examination of already existing and emerging technologies, on going research efforts, as well as development and documentation of effective tactics, techniques and procedures that fully support the deployment of tactical communication networks which operate in a fashion that enables Network Centric Operations.

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